

REMARKS

Claims 1-5 are pending in the present application. No new matter has been added by way of the present submission. For instance, claim 1 has been amended to more clearly recites how the heating temperature of the semiconductor substrate is set and adjusted. Support for this amendment can be found in paragraph [0022] and Figs. 1 and 2 of the present application. Thus, no new matter has been added.

In view of the following remarks, the Examiner is respectfully requested to withdraw all rejections and allow the currently pending claims.

Issue under 35 U.S.C. § 112, first paragraph

Claim 1 is rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. This rejection is respectfully traversed.

Applicants have deleted the phrases regarding the "the radiant heating" in claim 1, namely "by radiant heating", "adjusting said heating temperature caused by said radiant heating", and "from said radiant heating". Accordingly, it is respectfully requested that this rejection be withdrawn.

Issues under 35 U.S.C. § 103(a)

Claims 1-4 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Iguchi, US 2003/0186520 (hereinafter referred to as Iguchi '520).

Further, claim 5 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Iguchi '520 in view of Yoon, US 2003/0077870 (hereinafter referred to as Yoon '870).

Applicants respectfully traverse each of the above rejections.

The Present Invention and its Advantages

Independent claim 1 relates to a vapor phase growth method for growing an epitaxial layer on a semiconductor substrate, comprising:

measuring a resistivity of arbitrary semiconductor substrates at a room temperature;

obtaining respectively a relationship between a heating temperature and a temperature of a surface of the arbitrary semiconductor substrates, for the arbitrary semiconductor substrates having different resistivities;

setting and adjusting said heating temperature of a semiconductor substrate to be used based on (i) a measured resistivity of the semiconductor substrate to be used and (ii) the obtained relationship between the heating temperature and the temperature of the surface of said semiconductor substrate; and

growing the epitaxial layer, wherein the temperature of said surface of said semiconductor substrate to be used is indirectly controlled by adjusting said heating temperature.

The present invention was made on the basis of the following findings:

(1) Each substrate has its own resistivity at room temperature. Thus, even substrates cut out from the same ingot can incrementally differ in their resistivity (e.g., differ little by little) at room temperature when the cutting positions thereof vary with each other (refer to FIG. 2).

(2) When the substrates differ in their resistivity at room temperature, the degree of the surface temperature rise of the substrates is different. For instance, the temperature rise may be caused by receiving heat from the apparatus (e.g., MBE apparatus) at the time of the epitaxial growth. In other words, the thermal difference generated between the heating temperature which is set for the apparatus and the actual surface temperature of the substrates depends on the

difference in the resistivities of the substrates at room temperature. Thus, substrates having the same resistivity at room temperature share the same thermal difference between the heating temperature and the actual surface temperature of the substrates. Such were the discoveries of the present inventors.

Based on the above described findings, in order to obtain the desired degree of the actual surface temperature of the substrates, the present invention discloses the following configuration. That is:

1. The resistivity of arbitrary semiconductor substrates at a room temperature is measured;
2. The relationship between the heating temperature and the temperature of the substrate surface is obtained, for each of the arbitrary semiconductor substrates having different resistivities;
3. The heating temperature is set and adjusted based on (i) the measured resistivity of the semiconductor substrate to be used and (ii) the above mentioned obtained relationship.

According to this configuration (which is recited in claim 1), the heating temperature indicated, for example, by a thermocouple and the like, can be adjusted in accordance with the difference of the substrates (the difference in their resistivity at the room temperature), based on the thermal difference to be generated between the heating temperature and the actual surface temperature of the substrates. Such steps have been taken by the present inventors for the first time.

Additionally, due to the practicing of these new steps, unexpected superior results can be achieved. That is, the surface temperature of the substrate can be controlled accurately so as to

be at a desired temperature. Thus, an epitaxial layer having a stable quality can be grown with superior reproducibility, and a semiconductor element having superior characteristic can be manufactured stably (paragraph [0016] in the specification).

Distinctions Between the Present Invention and the Cited Art

In contrast to the present invention, the disclosure of Iguchi '520 has no relevance to adjusting the heating temperature so that the surface temperature of the substrate is accurately controlled to be at a desired temperature. Further, the cited reference fails to suggest or disclose the features of the present invention, namely the steps defining the configuration of claim 1.

Applicants take this opportunity to point out that the thermocouple T disclosed in Iguchi '520 (paragraph [0060]) is commonly used for monitoring the heating temperature, not for monitoring the temperature of the substrate surface. This can be shown from the fact that the thermocouple T is not directly placed on the substrate W in Iguchi '520 (Fig. 4B). Notably, as mentioned above, there is a thermal difference between the temperature shown by the thermocouple T and the actual temperature of the substrate surface. Further, "the predetermined temperature" ranges as much as from 550°C to 580°C in Iguchi '520, which is far from being accurately controlled. Thus, the disclosure of Iguchi '520 cannot be interpreted as leading one of skilled in the art to accurately control the surface temperature of the substrates so as to be at a desired temperature.

The Examiner points out in page 4 of the Office Action that the temperature is proportional to the resistivity. While it is true that an approximate value of the resistivity at which the epitaxial growth is being performed may be obtained from the resistivity at the room

temperature by certain well-known formulae defining the relationship between the temperature and the resistivity, this does not have much significance to the present invention.

Since the actual surface temperature is unlikely to share the same degree of temperature as the heating temperature, the thermal difference between the heating temperature and the actual surface temperature of the substrates should be previously obtained in order to accurately control the actual surface temperature. In this regard, Applicants would like to point out that using the above mentioned thermal difference in order to accurately control the actual surface temperature of the substrates is one of the most significant features of the presently claimed invention, which is neither disclosed nor suggested in the Iguchi '520. Thus, claims 1-5 are patentable. Moreover, the secondary disclosure of Yoon '870 cannot cure these deficiencies.

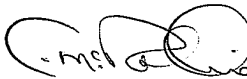
In view of the foregoing, since both the configuration of the presently claimed invention and the unexpected results obtained by the configuration are not suggested from the cited references, it is submitted that the present claims are patentable over the cited art, and the present application now stands in condition for allowance.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Craig A. McRobbie, Reg. No. 42,874, at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37.C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

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Respectfully submitted,

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